Pillars of the Eagle Nebula:
Can We Make Them Here on Earth?

California Science Content Standards

The Science Standards for Grades Six through 12 that pertain to the subject matter for this Science on Saturday presentation have been summarized here for use by teachers. The numbering and lettering that are used in the California State Science Standards have been preserved in order that teachers can refer to them in context.

Grade Six

Heat (Thermal Energy) (Physical Science)

a. Students know energy can be carried from one place to another by heat flow or by waves, including water, light and sound waves, or by moving objects.

d. Students know heat energy is also transferred between objects by radiation (radiation can travel through space).

Grade Eight

Focus on Physical Science

Motion

1. The velocity of an object is the rate of change of its position. As a basis for under-standing this concept:

a. Students know position is defined in relation to some choice of a standard reference point and a set of reference directions.

d. Students know the velocity of an object must be described by specifying both the direction and the speed of the object.

e. Students know changes in velocity may be due to changes in speed, direction, or both.

Forces

2. Unbalanced forces cause changes in velocity. As a basis for understanding this concept:

g. Students know the role of gravity in forming and maintaining the shapes of planets, stars, and the solar system.

Earth in the Solar System (Earth Science)

4. The structure and composition of the universe can be learned from studying stars and galaxies and their evolution. As a basis for understanding this concept:

a. Students know galaxies are clusters of billions of stars and may have different shapes.

b. Students know that the Sun is one of many stars in the Milky Way galaxy and that stars may differ in size, temperature, and color.

c. Students know how to use astronomical units and light years as measures of distances between the Sun, stars, and Earth.

d. Students know that stars are the source of light for all bright objects in outer space and that the Moon and planets shine by reflected sunlight, not by their own light.

e. Students know the appearance, general composition, relative position and size, and motion of objects in the solar system, including planets, planetary satellites, comets, and asteroids.

Grades Nine Through Twelve

Physics

Motion and Forces

1. Newton's laws predict the motion of most objects. As a basis for understanding this concept:

d. Students know that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction (Newton's third law).

Waves

4. Waves have characteristic properties that do not depend on the type of wave. As a basis for understanding this concept:

a. Students know waves carry energy from one place to another.

e. Students know radio waves, light, and X-rays are different wavelength bands in the spectrum of electromagnetic waves whose speed in a vacuum is approximately 3×10^8m/s (186,000 miles/second).

Grades Nine Through Twelve

Chemistry

Nuclear Processes

11. Nuclear processes are those in which an atomic nucleus changes, including radioactive decay of naturally occurring and human-made isotopes, nuclear fission, and nuclear fusion. As a basis for understanding this concept:

b. Students know the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by $E = mc^2$) is small but significant in nuclear reactions.

Grades Nine Through Twelve

Earth Sciences

Earth's Place in the Universe

1. Astronomy and planetary exploration reveal the solar system's structure, scale, and change over time. As a basis for understanding this concept:

a. Students know how the differences and similarities among the sun, the terrestrial planets, and the gas planets may have been established during the formation of the solar system.

b. Students know the evidence from Earth and moon rocks indicates that the solar system was formed from a nebular cloud of dust and gas approximately 4.6 billion years ago.

2. Earth-based and space-based astronomy reveal the structure, scale, and changes in stars, galaxies, and the universe over time. As a basis for understanding this concept:

a. Students know the solar system is located in an outer edge of the disc-shaped Milky Way galaxy, which spans 100,000 light years.

b. Students know galaxies are made of billions of stars and comprise most of the visible mass of the universe.

d. Students know that stars differ in their life cycles and that visual, radio, and X-ray telescopes may be used to collect data that reveal those differences.

g.* Students know how the red-shift from distant galaxies and the cosmic background radiation provide evidence for the "big bang" model that suggests that the universe has been expanding for 10 to 20 billion years.

Grades Nine Through Twelve

Investigation and Experimentation

1. Scientific progress is made by asking meaningful questions and conducting careful investigations. Students will:

g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.

i. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena

k. Recognize the cumulative nature of scientific evidence.